

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1-4. (Canceled)

5. (Currently amended) A method for writing data to a cache memory wherein a data write-in request is issued from an information processor to a storage control apparatus, the storage control apparatus including a plurality of channel control units each having an interface with the information processor; a disk control unit having an interface with a storage device for storing data; a local cache memory disposed in each channel control unit for temporarily storing data to be interchanged between the information processor and the storage device; a dedicated data transfer path between at least two of the local cache memories; a connector unit to provide data paths among the plurality of channel control units and the disk control unit separate from the dedicated data transfer path; [[and]] a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the method comprising:

receiving data to be written from the information processor;

writing the data to be written to a first [[the]] local cache memory of a first channel control unit, wherein if the first local cache memory does not have sufficient capacity to store the data to be written then first transmitting an amount of data stored in the first local cache memory to the global cache memory by way of the connector unit in order to obtain sufficient capacity in the local cache memory to store the data to be written;

transmitting the data to be written through the dedicated data transfer path to a second channel control unit connected to the first channel control unit;

writing the transmitted data to a second [[the]] local cache memory of the second channel control unit;

receiving through the dedicated data transfer path an acknowledgement indicating that writing of the transmitted data to the second local cache memory disposed in the second channel control unit has completed; [[and]]

transmitting the acknowledgement to the information processor to notify the information processor that data written to the second local cache memory of the second channel control unit has completed;

writing data in the first local cache memory and the second local cache memory which is not yet reflected to the global cache memory out to the global cache memory to reflect the data into the global cache memory;

removing power from the first channel control unit and the second channel control units after the data is reflected into the global cache memory;

writing data in the global cache memory which is not yet reflected to the disk drive out to the disk drive to reflect the data into the disk drive; and

removing power from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

6. (Currently amended) A method in a storage control apparatus for reading in data stored in a second cache memory to a first cache memory, the storage control apparatus including a plurality of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; a plurality of first cache memories each being disposed in one of the channel control units for temporarily storing data to be interchanged between the information processor and the storage device, the first cache memory of at least two of the channel control units being connected to one another through a dedicated data transfer path; [[and]] a connector unit to provide data paths among the plurality of channel control units and the disk control unit separate from the dedicated data transfer path, the connector unit being connected to the second cache memory; a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the method comprising:

transmitting a read-out command of the data to the second cache memory;
acquiring the data from the second cache memory;
writing the acquired data to a [[the]] first cache memory of a first channel control unit, wherein if the first cache memory does not have sufficient capacity to store the acquired data then first transmitting an amount of data stored in the first cache memory to the second cache memory by way of the connector unit in order to obtain sufficient capacity in the first cache memory to store the acquired data;

transmitting the acquired data through the dedicated data transfer path from the first cache memory of the first channel control unit to the first cache memory of a second channel control unit; [[and]]

receiving an acknowledgement from the second channel control unit indicating that the acquired data has been written to the first cache memory of the second channel control unit;

writing data in the first cache memory of the first channel control unit and the first cache memory of the second control unit which is not yet reflected to the global cache memory out to the global cache memory to reflect the data into the global cache memory;

removing power from the first channel control unit and the second channel control unit after the data is reflected into the global cache memory;

writing data in the global cache memory which is not yet reflected to the disk drive out to the disk drive to reflect the data into the disk drive; and

removing power from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

7. (Currently amended) A method performed by a channel control unit for reading out data wherein a data read-out request is issued from an information processor to a storage control apparatus, the storage control apparatus including a plurality of channel control units each having an interface with the information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory in each of the channel

control units for temporarily storing data, to be interchanged between the information processor and the storage device, the first cache memory of at least two of the channel control units being connected to one another through a dedicated data transfer path; a plurality of second cache memories; [[and]] a connector unit to provide data paths among the plurality of channel control units and the disk control unit separate from the dedicated data transfer path, the connector unit being connected to the second cache memories; a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the method comprising:

receiving from the information processor a read-out command for data for which an address is specified;

determining whether the data at the specified address is stored in the first cache memory of a first channel control unit;

transmitting a read-out command of the data to one of the second cache memories if the data at the specified address is not stored in the first cache memory of the first channel control unit;

acquiring the data from said one of the second cache memories;

writing the acquired data to a [[the]] first cache memory of the first channel control unit, wherein if the first cache memory does not have sufficient capacity to store the acquired data then first transmitting an amount of data stored in the first cache memory to said one of the second cache memories by way of the connector unit in order to obtain sufficient capacity in the first cache memory to store the acquired data;

transmitting the acquired data through the dedicated data transfer path to a second channel control unit connected to the first channel control unit;

receiving from the second channel control unit an acknowledgement indicating that writing of the acquired data to the first cache memory disposed in the second control unit has completed; [[and]]

transmitting the acquired data to the information processor;

writing data in the first cache memory and said one of the second cache memories which is not yet reflected to the global cache memory out to the global cache memory to reflect the data into the global cache memory;

removing power from the first channel control unit and the second channel control unit after the data is reflected into the global cache memory;

writing data in the global cache memory which is not yet reflected to the disk drive out to the disk drive to reflect the data into the disk drive; and

removing power from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

8-11. (Canceled)

12. (Currently amended) A channel control unit in a storage control apparatus including a plurality of channel control units; a disk control unit having an interface with a storage device for storing data; a dedicated data transfer path; a second cache memory; [[and]] a connector unit to provide data paths among the plurality of channel control units; a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the disk control unit and the second cache memory being memories separate from the dedicated data transfer path, the connector unit being connected to the second cache memory, each channel control unit comprising:

a first cache memory for temporarily storing data to be interchanged between an [[the]] information processor and the storage device, the first cache memory of at least two of the channel control units being connected to one another by the dedicated data transfer path for storing mutually [[the]] temporarily stored data;

a first interface for transmitting to a [[the]] second cache memory a read-out command for data stored in the second cache memory;

an acquiring portion for acquiring the data from the second cache memory;
a writing portion for writing the acquired data to the first cache memory;

a second interface for transmitting the acquired data through the dedicated data transfer path to another channel control unit; and

a receiver for receiving from said another channel control unit an acknowledgement notifying that the writing of the transmitted data to the first cache memory disposed in said another channel control unit has completed,

wherein the first interface transmits further for transmitting an amount of data from the first cache memory to the second cache memory via the connector unit when the first cache memory has insufficient capacity to store data to be written, the amount of data that is transmitted being sufficient to increase the capacity of the first cache memory,

wherein data in the first cache memory and the second cache memory which is not yet reflected to the global cache memory is written to the global cache memory to reflect the data into the global cache memory,

wherein power is removed from the plurality of channel control units after the data is reflected into the global cache memory,

wherein data in the global cache memory which is not yet reflected to the disk drive is written to the disk drive to reflect the data into the disk drive; and

wherein power is removed from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

13. (Currently amended) A channel control unit in a storage control apparatus including a plurality of channel control units; a disk control unit having an interface with a storage device for storing data; a dedicated data transfer path; at least one second cache memory; [[and]] a connector unit to provide data paths among the plurality of channel control units; a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the disk control unit and the at least one second cache memory separate from the dedicated data transfer path, the connector unit being connected to the at least one second cache memory, each channel control unit comprising:

an interface with an information processor;

a first cache memory for temporarily storing data to be interchanged between the information processor and the storage device, the first cache memory of at least two of the channel control units being connected to one another through the dedicated data transfer path;

a receiver for receiving from the information processor a read-out command for data for which an [[the]] address is specified;

a determining portion for determining whether the data at the specified address is stored in the first cache memory;

a transmitter for transmitting the read-out command for the data to the at least one second cache memory if the data at the specified address is not stored in the first cache memory;

an acquiring portion for acquiring the data from the at least one second cache memory;

a writing portion for writing the acquired data to the first cache memory, wherein if the first cache memory does not have sufficient capacity to store the acquired data then an amount of data stored in the first cache memory first is first transferred to the at least one second cache memory by way of the connector unit sufficient to obtain capacity in the first cache memory to store the acquired data;

a transmitter for transmitting the acquired data through the dedicated data transfer path to another channel control unit;

a receiver for receiving from said another channel control unit an acknowledgement indicating that the writing of the acquired data to the first cache memory disposed in said another channel control unit has completed; and

a transmitter for transmitting the acquired data to the information processor,
wherein data in the first cache memory and the at least one second cache memory
which is not yet reflected to the global cache memory is written to the global cache memory to
reflect the data into the global cache memory,

wherein power is removed from the plurality of channel control units after the
data is reflected into the global cache memory,

wherein data in the global cache memory which is not yet reflected to the disk drive is written to the disk drive to reflect the data into the disk drive; and

wherein power is removed from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

14-16. (Canceled)

17. (Currently amended) A computer-readable medium containing a computer program executed on a first channel control unit in a storage control apparatus including a plurality of channel control units each having an interface with an [[the]] information processor; a disk control unit having an interface with a storage device for storing data; a local cache memory in each channel unit for temporarily storing data to be interchanged between the information processor and the storage device, the local cache memory of at least two of the plurality of channel control units being connected to one another through a dedicated data transfer path used for storing mutually the temporarily stored data; a connector unit to provide data paths among the plurality of channel control units and the disk control unit separate from the dedicated data transfer path; [[and]] a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the computer program configured to cause the first channel control unit to perform steps comprising:

receiving data to be written from the information processor;

writing the data to be written to a [[the]] local cache memory of the first channel control unit, wherein if the local cache memory does not have sufficient capacity to store the data to be written then first transmitting an amount of data stored in the local cache memory to the global cache memory by way of the connector unit in order to obtain sufficient capacity in the local cache memory to store the data to be written;

transmitting the data to be written through the dedicated data transfer path to a second channel control unit connected to the first channel control unit;

writing the transmitted data to the local memory of the second channel control unit;

receiving from the second channel control unit through the dedicated data transfer path an acknowledgement indicating that the writing of the data to the local cache memory disposed in the second channel control unit has completed; [[and]]

transmitting the acknowledgement to the information processor;

writing data in the local cache memory of the first channel control unit and the local cache memory of the second control unit which is not yet reflected to the global cache memory out to the global cache memory to reflect the data into the global cache memory;

removing power from the first channel control unit and the second channel control unit after the data is reflected into the global cache memory;

writing data in the global cache memory which is not yet reflected to the disk drive out to the disk drive to reflect the data into the disk drive; and

removing power from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

18. (Currently amended) A computer-readable medium containing a computer program executed on a first channel control unit in a storage control apparatus including a plurality of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory in each channel unit for temporarily storing data to be interchanged between the information processor and the storage device, the first cache memory of at least two of the plurality of channel control units being connected to one another through a dedicated data transfer path used; at least two second cache memories; [[and]] a connector unit to provide data paths among the plurality of channel control units; a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the disk control unit and the at least two second cache memories being separate from the dedicated data transfer path, the connector unit being connected to the at least two second cache memories memory, the computer program configured to cause the first channel control unit to perform steps comprising:

transmitting to one of the second cache memories a read-out command for data stored therein;

acquiring the data from the one of the second cache memories;

writing the acquired data to a [[the]] first cache memory of the first channel control unit, wherein if the first cache memory does not have sufficient capacity to store the acquired data then first transmitting an amount of data stored in the first cache memory to the second cache memory by way of the connector unit in order to obtain sufficient capacity in the first cache memory to store the acquired data;

transmitting the acquired data through the dedicated data transfer path to a second channel control unit connected to the first channel control unit; and

receiving from the second channel control unit an acknowledgement indicating that the writing of the acquired data to the first cache memory disposed in the second channel control unit has completed;

writing data in the first cache memory and the second cache memory which is not yet reflected to the global cache memory out to the global cache memory to reflect the data into the global cache memory;

removing power from the first channel control unit and the second channel control unit after the data is reflected into the global cache memory;

writing data in the global cache memory which is not yet reflected to the disk drive out to the disk drive to reflect the data into the disk drive; and

removing power from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

19. (Currently amended) A computer-readable medium containing a computer program executed on a first channel control unit in a storage control apparatus including a plurality of channel control units each having an interface with an information processor; a disk control unit having an interface with a storage device for storing data; a first cache memory in each channel unit for temporarily storing data to be interchanged between the

information processor and the storage device, the first cache memory of at least two of the plurality of channel control units being connected to one another through a dedicated data transfer path used for storing mutually the temporarily stored data; at least two second cache memories; [[and]] a connector unit to provide data paths among the plurality of channel control units; a global cache memory connected to the connector unit; and a disk drive connected to the global cache memory, the disk control unit and the second cache memories being separate from the dedicated data transfer path, the connector unit being connected to the second cache memories, the computer program configured to cause the first channel control unit to perform steps comprising:

receiving from the information processor a read-out command for data for which an [[the]] address is specified;

determining whether the data at the specified address is stored in a [[the]] first cache memory of the first channel control unit;

transmitting a read-out command for the data at the specified address to one of the second cache memories if the data is not stored in the first cache memory;

acquiring the data from said one of the second cache memories;

writing the acquired data to the first cache memory, wherein if the first cache memory does not have sufficient capacity to store the acquired data then first transmitting an amount of data stored in the first cache memory to said one of the second cache memories by way of the connector unit in order to obtain sufficient capacity in the first cache memory to store the acquired data;

transmitting the acquired data through the dedicated data transfer path to a second channel control unit connected to the first channel control unit;

receiving from the second channel control unit an acknowledgement indicating that the writing of the acquired data to the first cache memory disposed in the second channel control unit has completed; [[and]]

transmitting the acquired data to the information processor;

writing data in the first cache memory and said one of the second cache memories which is not yet reflected to the global cache memory out to the global cache memory to reflect the data into the global cache memory;

removing power from the first channel control unit and the second channel control unit after the data is reflected into the global cache memory;

writing data in the global cache memory which is not yet reflected to the disk drive out to the disk drive to reflect the data into the disk drive; and

removing power from the global cache memory, the disk control unit, and the disk drive after the data is reflected to the disk drive.

20-22. (Canceled)